

INTEGRATED ENGINEERING CAPABILITY

Design and Data Management System (DDMS)

Overview of NASA MSFC IEC Multi-CAD Collaboration
Capability

March 2005

Presenter: Brett Moushon
IEC DDMS Team



"Engineering Excellence Enabling our Customers' Mission Success"

Brett Moushon (Moo-Shawn)

- Resides in Tucson, AZ and is currently a member of NASA's MSFC Engineering Directorate (ED03) IEC Team
- Is a leading PLM Integrator with 15 years of industry experience in large scale enterprise deployments.
- As a Principal Consultant he has extensive industry experience in Aerospace and Defense, Discrete Manufacturing, and Engineering Systems Working with companies such as NASA, Boeing FCS, Lockheed Martin Systems Integration, Motorola Space and Government, Caterpillar, John Deere, Agco.
- As a Program Manager for Parametric Technology Corporation, Brett lead several large scale Windchill implementations. He helped create PTC's Windchill Academy, and led the development of the PTC's Windchill Implementation Methods.



IEC Mission

Marshall Space Flight Center

Integrated Engineering Capability



***The Integrated Engineering Capability mission is to
improve the accuracy, availability, and control of engineering data
through establishment of
data automation and integration capabilities
based on MSFC policies and processes.***

IEC Alignment to Agency Strategy

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Integrated Engineering Capability

The IEC Project aligns directly with the 2003 NASA Strategic Plan¹, OneNASA², CAIB³, The Vision for Space Exploration⁴, and NASA's Direction for 2005 and Beyond⁵ by:

- establishing collaborative engineering capabilities
- improving data management and control
- providing CAD design, translation, and integration capabilities
- providing as-designed vs as-built product management
- reducing life-cycle costs
- providing project metrics and management decision tools

¹ 2003 NASA Strategic Plan implementing strategy, IS-3 - "implement collaborative engineering capabilities and integrated design solutions to reduce the life-cycle cost and technical, cost, and schedule risk of major programs".

² OneNASA recommendation 6 - "enhance cross-Agency collaboration by putting in place common engineering and collaborative tools and databases, processes, and knowledge-sharing structures".

³ CAIB finding F7.4-11 - "the Space Shuttle Program has a wealth of data tucked away in multiple databases without a convenient way to integrate and use the data for management, engineering, or safety decisions" and finding F10.3-1 - "the engineering drawing system contains outdated information and is paper-based rather than computer-aided".

⁴ The Vision for Space Exploration - "develop the innovative technologies, knowledge, and infrastructures both to explore and to support decisions about the destinations for human exploration".

⁵ NASA's Direction for 2005 and Beyond, NASA's Guiding National Objective #3 - "Develop innovative technologies, knowledge, and infrastructure both to explore and to support decisions about the destinations for human exploration."

IEC DDMS Framework

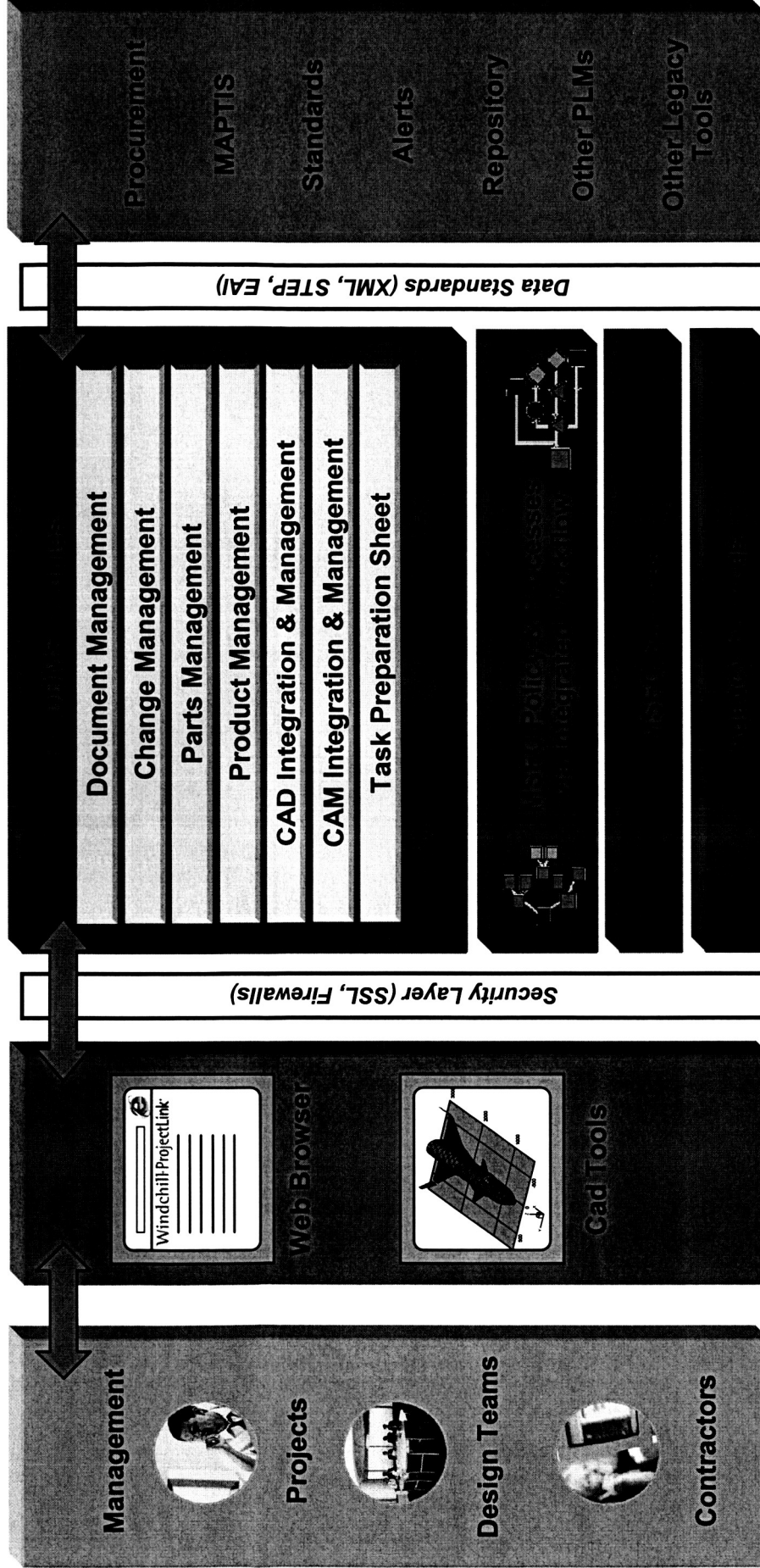
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Integrated Engineering Capability

Users
User Interfaces

MSFC Windchill Environment

External Systems





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Integrated Engineering Capability

Windchill.

by Windchill®

Dashboard of all User's Projects

**Handles Sensitive
Data through
Marking and Access
Control**

[Projects List](#) | [Details](#) | [Folders](#) | [Plan](#) | [Team](#) | [Resources](#) | [Meetings](#) | [Assignments](#) | [Forum](#) | [Workspaces](#) | [Reports](#) | [Templates](#) | [Utilities](#)

Home	Product	Project	Change	Library	Organization	Site
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About Windchill

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Change Management



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Integrated Engineering Capability

PI Link EEN Worklow

File Process Help

Location: EEN Project Home

Set CAI and CAI Set EC

Start Submit ECIS at State Under Review

Amend CN Plan

Amend CN Plan

Java Applet Window

Control of All Specific CM Data in One Place

Windchill

Home Product Project Change Library Organization

Problem Reports Change Requests Change Directives Details

zChangeM3 Recent Changes:

Title: zChangeM3
 Number: CR-00000026
 Change Package Number: CP-00000027
 Source: zED400g (14981) - ZED40AGR, zED40agr
 Board: Approval Authority
 Approval Authority: gow.088a.msfc.approval.ApprovalAuthority.8851

Classification: Class 1

Approval Need Date:

Description: Third change

Change Type:

Justification:

Consequences if Not Incorporated:

Effectivity:

External Document Impacts:

Related Change Requests:

Total Cost Est:

ACI Restrictions: Business/Company Confidential

Location: / zEd00d

Created By: zecrit

Modifier: zecrit

State: Preliminary Review

AFS Number:

Instructions:

Record Copy: No

Responsible Org:

Record Status:

CM Process Monitoring and Metrics

Monitor Changes for: [Entire System] [Go]

Open Closed

Problem Reports

Enterprise Change Request (ECRs)

Enterprise Change Notice (ECNs)

Full Track Vs. Fast Track Changes

Nov to Jan Combined

Average Days Open = 0.0

Open Problem Reports

Average Days Open = 5.7

Open ECNs

Average Days Open = 0.0

Open ECNs

All Special Reports

Average ECR Completion Time

Average ECN Completion Time

Average Problem Report Completion Time

Team: CR-00000026 (14981) - zChangeM3148

Created: 2004-11-12 13:21:29 CST

Last Updated: 2004-11-12 13:22:22 CST

Custodian:

Location:

Record Schedule:

Record Type:

1.0

Product Management



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Integrated Engineering Capability

Windchill

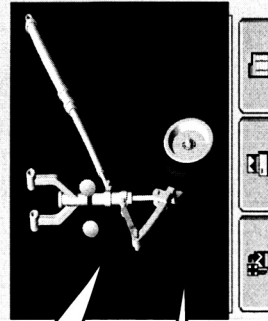
Home Product Protect Change Library Organization
Products List Details Folders Product Structure Team Change Monitor Forum Templates Utili
Crew Exploration Vehicle Recent Products: [Go]

this stupid little field is only 60 characters, the end is .

Imbedded Visualization with resize, rotate, measuring, and mark-up capabilities.

View Designs without CAD Tools

Crew Exploration Vehicle [Actions--] [Go]



Organization ID: Demo Organization
Responsible Product: Crew Exploration Vehicle
Number: CEV
Name: Crew Exploration Vehicle
Version: A.2
Type: Separable
Source: Make
View: [Go]
Status: Checked in
Location: / Crew Exploration Vehicle

Product Structure -
Related Documents
Associated Changes
Used By Replacements Baselines
Effectivity
End Item Configurations
End Item Instances
Versions
Iteration History

Create and Edit Product Structure Effectivity, Versions, and Views.

Configuration: Latest 'Design' including work in progress

Capability to Manage, Navigate, and Visualize Product Structure

Product Structure		Expand		Collapse	
Copy	Add to Protect	Expand One	Expand All		
Name	Actions	Number	CEV	CEV-DART-001	GC0000040
Crew Exploration Vehicle	[Expand]				
DART	[Expand]				
WHEEL ASSY	[Expand]				
Windchill PDM Lib Test Part	[Expand]				

2.0

Federated Systems



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Test: Simple Product Structure - Microsoft Internet Explorer provided by PTC

Product Structure

Shows Indentured Parts List

Name	Number	Details	Source System	State	Version
Tank Assembly	S51356545	①	JSC	In Work	A.2
Tank Structure	S51329151-305	①	JSC	In Work	A.1
Propellant System	M21043-04	①	MSFC	In Work	A.1
Tank Thermal System	NAS1149C	①	JSC	In Work	A.1

Brings Data from All Federated Systems into One Environment

Uses Common Agency Part Definition

Provides Integrated Intercenter Reports

Intercenter Search from One Location

Search: <http://dlflowe.net.ptc.com/Windchill70/wtcore/jst>

Search

Documents | Parts | Changes | Workflow

Simple Search | Composite Search | List All

Back to top

NASA Parts

Name	Number	Details	Source System	State	Version
ARM ASSY, PIVOT, LIM SW-FWD TRUNNION MECHANISM	SEK51340151-301	①	JSC	In Work	A.2
ARM, PIVOT, LIM SW-FIN FOLD MECH	SDK51340152-303	①	JSC	In Work	A.1
SCREW, CAP, SOCKET HEAD	0000000124	①	MSFC	In Work	A.1
BAR, CAM, ARM, PIVOT, FM, FIN	SDK51356545-301	①	JSC	In Work	A.1

Improves Visibility and Configuration Control Across Centers

Maintains Local Access Rules of Host System

2.0

User's Task Home Page



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Home Tab
Consolidates All
User Work for both
Products and
Projects

Rolling list of
recently accessed
items for immediate
recall

List of All User
Assigned Work

List of All User
Checked Out Work

On-Line Help and
Web Based Tutorials

Integrated Search
Capabilities Across
Project and Products

Search within
User's Work Items

Filters for sorting
table data

Overview - Microsoft Internet Explorer provided by MSFC

File Edit View Favorites Tools Help

Address http://m616755.msfc.nasa.gov/pdmlink/netmarkets/isp/netmarkets/view.jsp

Windchill-PDMLink

Home Product Change Library Organization Site

Overview Assignments Updates Checked-Out Work Meetings Notebook Subscriptions Reports Utilities

Welcome, Jomo Recently Accessed

Last Login: Jan 29, 2004, 3:40 PM CST

Search within my work.

Search

Learn | Help | Publications | E-mail Page | Hot Links | Copy Page

Current View: Open by Due Date

Name	Actions	Subject	State	Deadline	Assigned	Context
Submit ECR	See Actions	test ECR	Open		Jan 27, 2004	GOLF_CART
Complete ECN Task	See Actions	taskona	Implementation		Jan 29, 2004	my test project123
Create ECN	See Actions	asdasdasd	Implementation		Jan 29, 2004	my test project123

View All

Current View: Most Recent

Name	Number	Actions	State	Last Modified	Version	Context
my workflow test	00041	See Actions	Resolved	Jan 29, 2004, 4:08 PM		my test project123
asdasdasd	00044	See Actions	Implementation	Jan 29, 2004, 4:08 PM		my test project123
ECN2	00042	See Actions	Implementation	Jan 29, 2004, 4:08 PM		my test project123
Soft type ECR	00042	See Actions	Implementation	Jan 29, 2004, 3:19 PM		my test project123
my test project123	123456-123	See Actions	In Work	Jan 27, 2004, 2:09 PM	A	my test project123
test ECR	00041	See Actions	Open	Jan 27, 2004, 1:28 PM		GOLF_CART
document 1.2	0000000023	See Actions	In Work	Jan 14, 2004, 4:52 PM	A	Windchill PDM

View All

Checked-Out Work

Current View: All

Name	Number	Actions	State	Last Modified	Version	Context
No Items to Display						

View All

Done

Internet

1.0

Document Management

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Windchill

Learn | Help | Publications | E-mail Page | Hot Links | Copy Page

Home | Product | Project | Change | Details | Folders | Plan | Te

Learn | Help | Publications | E-mail Page | Hot Links | Copy Page

Recent Projects:

Projects List | Details | Folders | Plan | Team Resources Meetings Assignments Forum Workspaces Reports Templates Utilities

Status:  State: Running

This is just a test of ProjectLink

Search within this project:

My Projects

Name	Actions	Owner
DART	See Actions	Todd P
NAS8-12345	See Actions	Todd P
Project_001	See Actions	Mitchel
Todd's Test Project	See Actions	Todd P
X-37	See Actions	Todd P

Projects List | Details | Folders | Plan

Dashboard of all User's Projects

Handles Sensitive Data through Marking and Access Control

Current View: Folders and Contents

Name	Actions	State	Modified By	Last Modified
Changes	See Actions	Open		Mar 24, 2004, 4:44 PM
Change Payload Capacity	See Actions	Open		Mar 16, 2004, 11:20 AM
Test DART ECR	See Actions			Apr 9, 2004, 9:35 AM
Contracts	See Actions			Mar 24, 2004, 3:23 PM
NAS8-18731	See Actions			Mar 24, 2004, 3:24 PM
Test Contract Deliverable	See Actions	In Work	Todd Pare	Mar 24, 2004, 4:05 PM
General	See Actions			Mar 16, 2004, 10:30 AM
Project Plan	See Actions	In Work	Todd Pare	Mar 26, 2004, 9:10 AM
Project Plan	See Actions	In Work	Ron Newby	Mar 16, 2004, 2:33 PM
ITAR	See Actions			Mar 16, 2004, 10:43 AM
NASA Sensitive	See Actions			Mar 16, 2004, 10:44 AM
DART Level 2 Requirements Document	See Actions	In Work	Todd Pare	Mar 26, 2004, 9:40 AM
First Test	See Actions	In Work	Todd Pare	Mar 16, 2004, 11:46 AM
Level 0 Specification	See Actions	In Work	Todd Pare	Apr 7, 2004, 4:01 PM
Level 0 Specification	See Actions	In Work	Todd Pare	Mar 26, 2004, 10:25 AM

Projects List | Details | Folders | Plan | Team | Resources | Meetings | Assignments | Forum | Workspaces | Reports | Templates | Utilities

Home | Product | Project | Change | Library | Organization | Site

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1.0

Change Management



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Automated Change Management Process Workflow

Control of All Specific CM Data in One Place

CM Process Monitoring and Metrics

zChangeM3

Title: zChangeM3
Number: CR-00000026
Change Package Number: CP-00000027
Source: zED400g (14981) - ZED40AGR, zED40Ugr
Board: Approval Authority
gov.nasa.msfc.appoval.ApprovalAuthority.8651

Classification: Class 1
Approval Need Date:
Description: Third change
Change Type:
Justification:
Consequences if Not Incorporated:
Effectivity:
External Document Impacts:
Related Change Requests:
Total Cost Est:
ACI Restrictions: Business/Company Confidential

Location: /zProd
Created By: zecrnt
Modifier: zecrnt
State: Preliminary Review
AFS Number:
Instructions:
Record Copy: No
Responsible Org:
Record Status:

Team: CR-00000026 (14981) - zChangeM3148
Created: 2004-11-12 13:21:28 CST
Last Updated: 2004-11-12 13:22:22 CST
Custodian:
Location:
Record Schedule:
Record Type:

1.0

Product Management

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Windchill.

Windchill

Learn | Help

Home Product Project Change Library Organization

Products List | Details | Folders | Product Structure | Team | Change Monitor | Forum | Templates | Utilities

Crew Exploration Vehicle

Recent Products: [dropdown] [Go]

Crew Exploration Vehicle

Organization ID: Demo Organization

Responsible Product: Crew Exploration Vehicle

Number:	CEV
Name:	Crew Exploration Vehicle
Version:	A.2
Type:	Separable
Source:	Make
View:	
Status:	Checked in
Location:	/ Crew Exploration Vehicle

this stupid little field is only 60 characters. the end is .

**Imbedded
Visualization
with resize, rotate,
measuring, and
mark-up
capabilities**

View Designs without CAD Tools

Create and Edit Product Structure Effectively, Versions, and Views.

Configuration: Latest 'Design' including work in progress

Capability to Manage, Navigate, and Visualize Product Structure

Product Structure		Copy Add to Protect		Expand Collapse Refresh
Name	Actions	Number		
Crew Exploration Vehicle	①	CEV		
DART	①	CEV-DART-001		
WHEEL ASSY	①	GC0000040		
Windchill PDM Lib Test Part	①	0000000001		

Iteration History

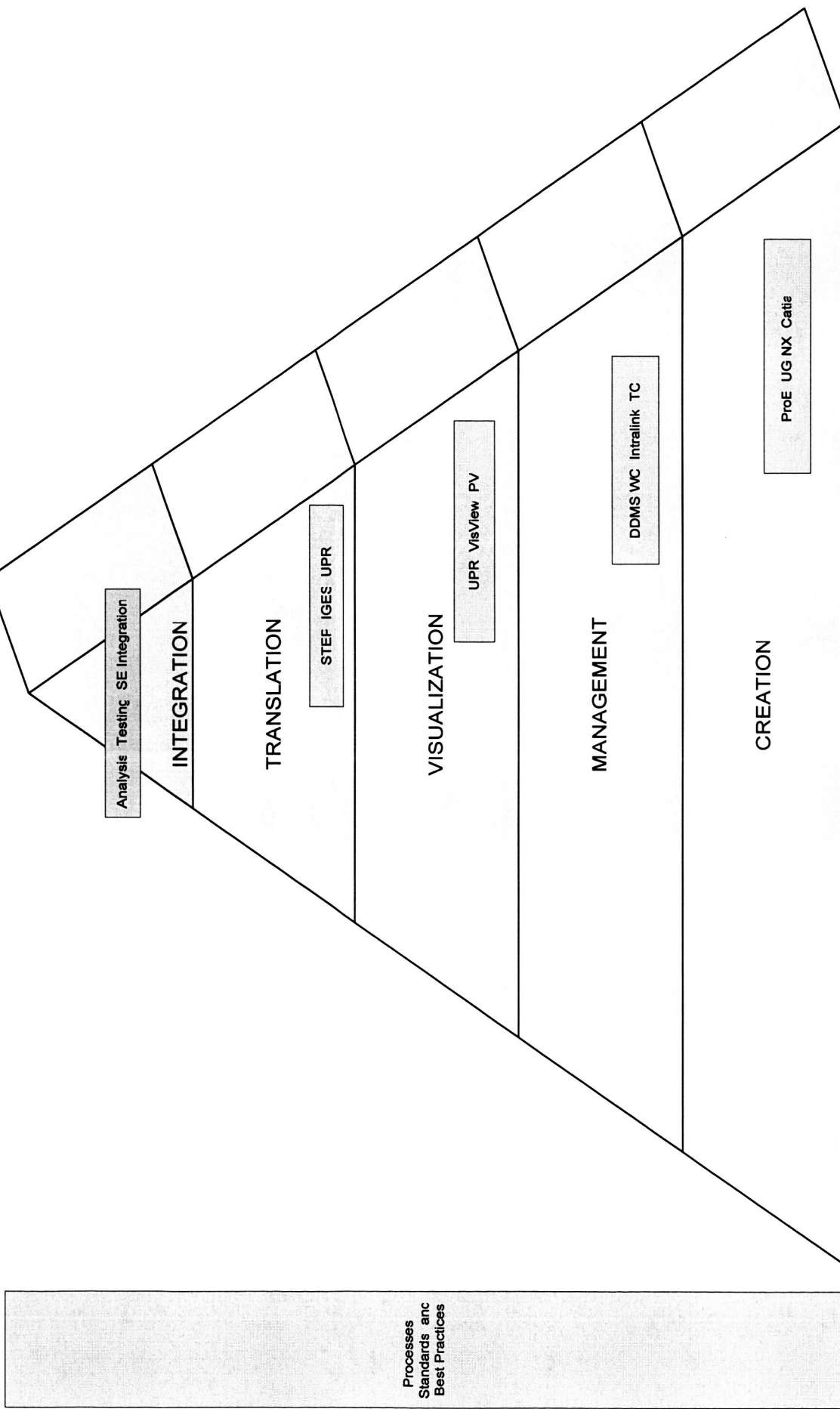
2.0

IEC Multi-CAD Support



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Integrated Engineering Capability





DDMS Multi-CAD Trade Analysis



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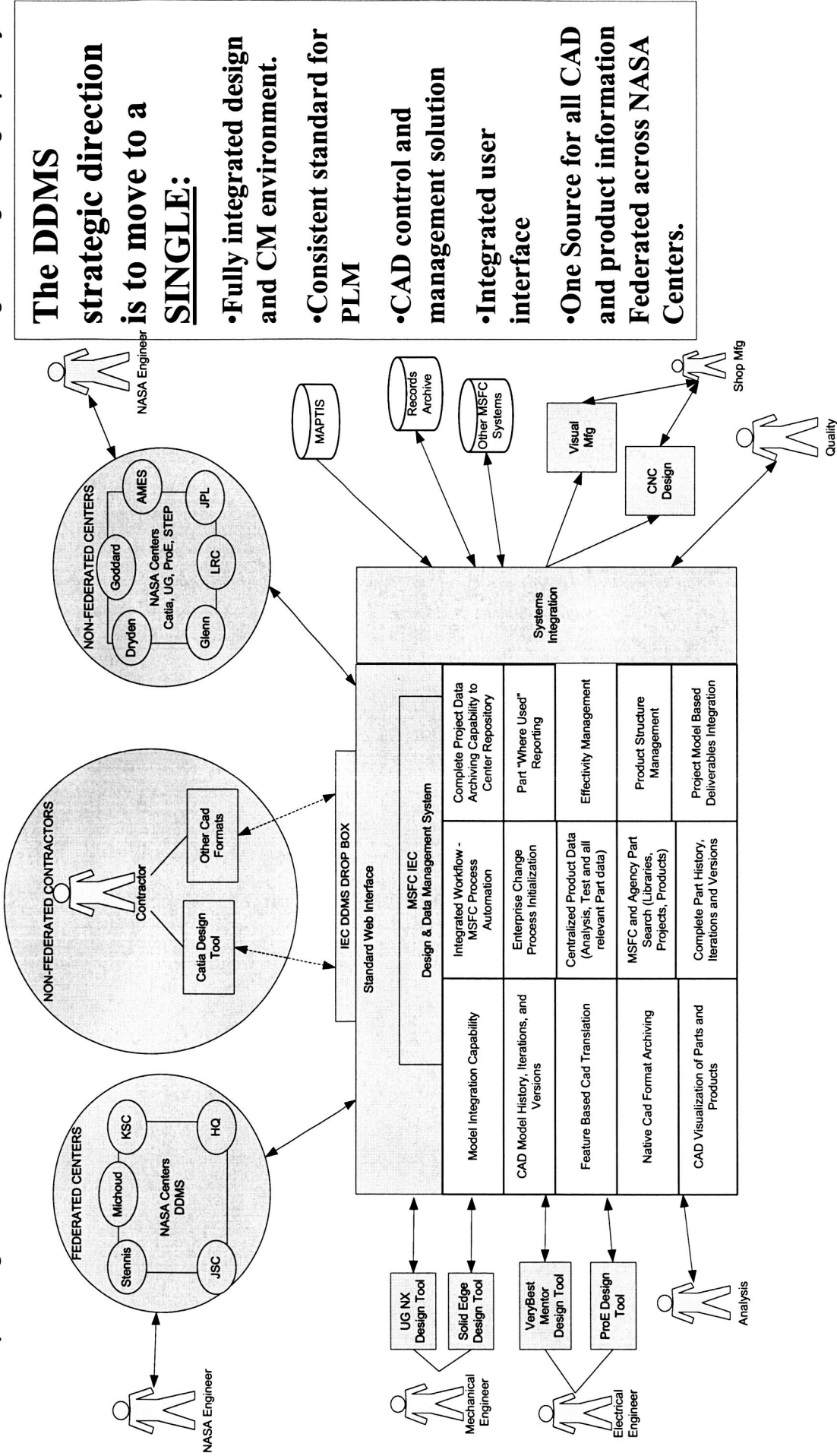
Integrated Engineering Capability

- “ONE NASA” Standard PLM and CAD Environment
 - NASA will always have the need to accommodate a Multi-CAD environment for individual Centers, Contractors, and Projects.
- Increased Teamcenter investment with integration via workflow to DDMS environment
 - Increased costs and conflicts with “Federated Agency Direction”
- Integrated engineering environment that accommodates Multi-CAD capability, Agency CM Standards, Agency NISE Infrastructure, ACI/EAR/ITAR policies, and Agency Federation Architecture.

IEC DDMS Integrated CAD Capability

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Integrated Engineering Capability



The DDMS strategic direction is to move to a SINGLE:

- Fully integrated design and CM environment.
- Consistent standard for PLM
- CAD control and management solution
- Integrated user interface
- One Source for all CAD and product information Federated across NASA Centers.

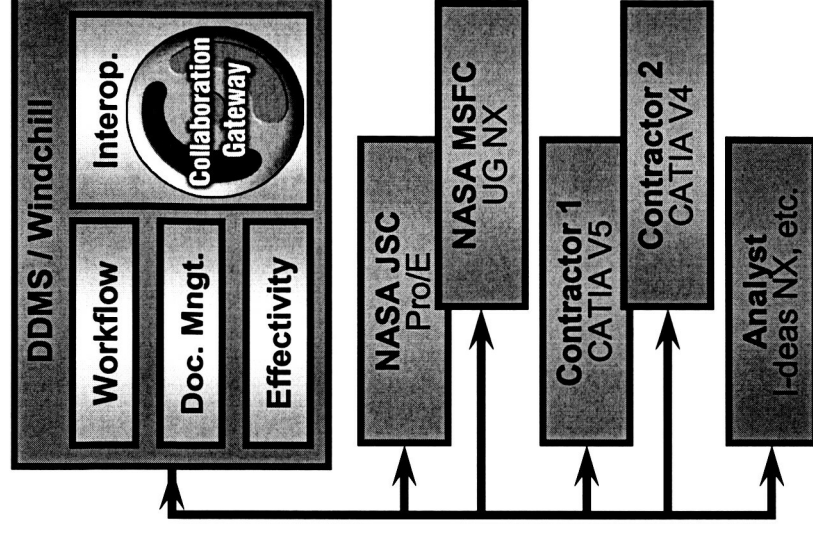
Interoperate Versus Translate



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Integrated Engineering Capability

- Divisions/Supplier/Contractors Use Disparate – But Productive – 3D Parametric Modeling Tools
- Feature Based Interoperability
 - Maintains Model Flexibility
 - Promotes Reuse and Efficiency
 - Service Oriented Approach in DDMS
 - Seamless Multi-CAD Integration
 - Windchill Controls Models Under CM
- Traditional Translators
 - Delete Model Flexibility
 - Requires Rebuilding, Rework



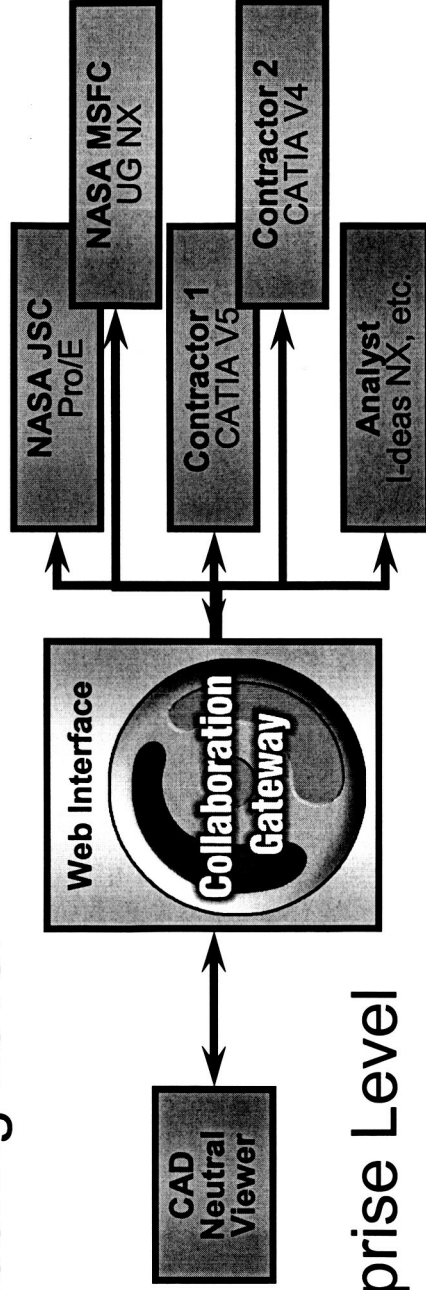
Possible Implementations



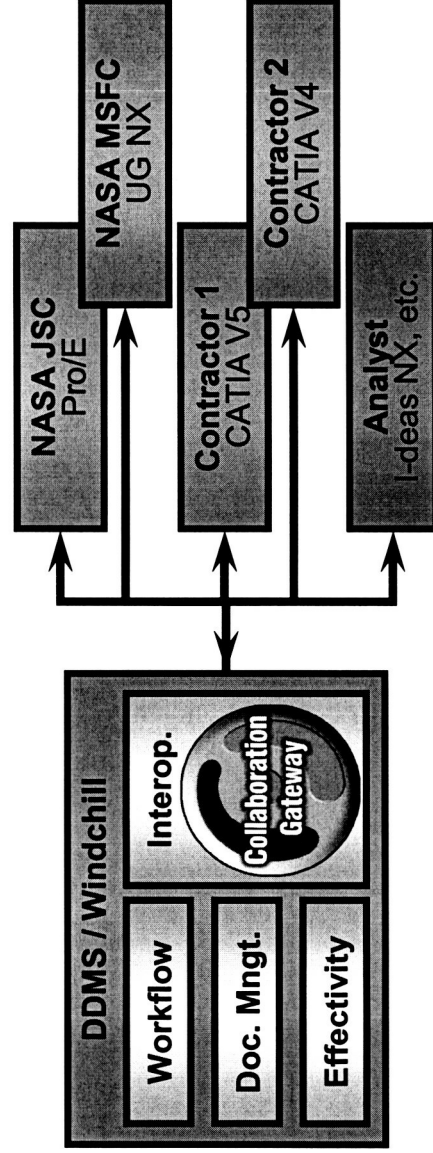
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Integrated Engineering Capability

- Engineering Level



- Enterprise Level



Check models in/out from the Model Tree

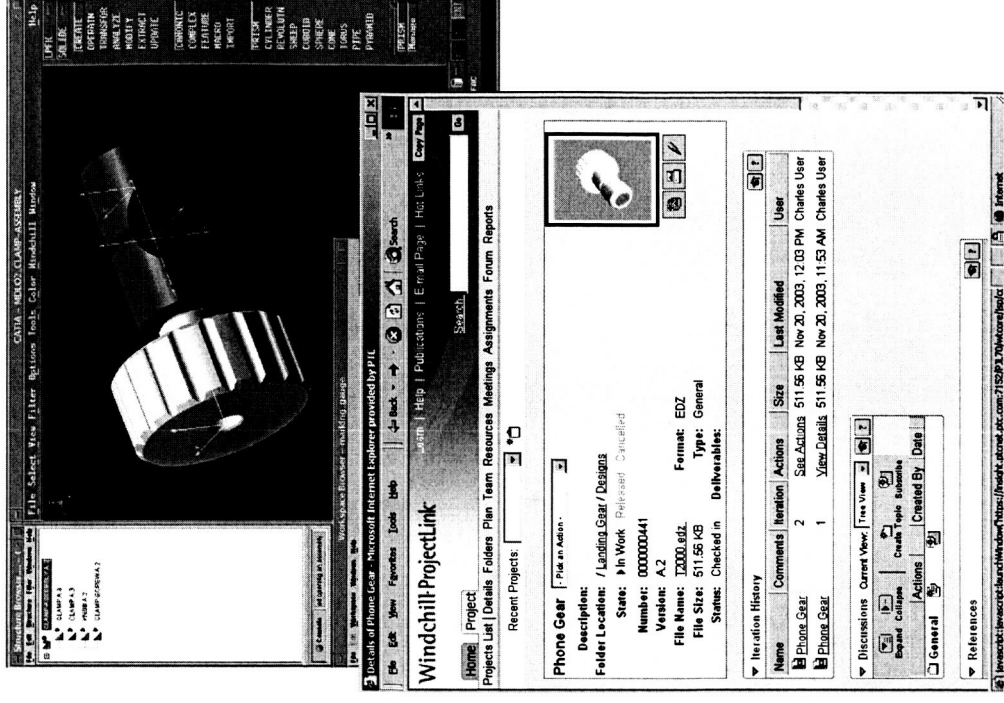
Embedded Web browser for Windchill PDMLink activities

Check-out models "on the fly" upon modification of parts and assemblies

Drag and drop models into Pro/ENGINEER

A single application view for CAD/CAM/CAE and PDM

- ◉ Manage multi-discipline design processes for MCAD – ECAD and Electrical – Software design
- ◉ Coordinate multiple, disparate design data directories
- ◉ Structure products from parts defined in different CAD formats
 - Divisions using different CAD tools to design components of same product
- ◉ Visualize product structures of data defined in different CAD formats
- ◉ Manage parts defined by multiple CAD tools
 - Different customers require different formats
 - Different departments use different applications

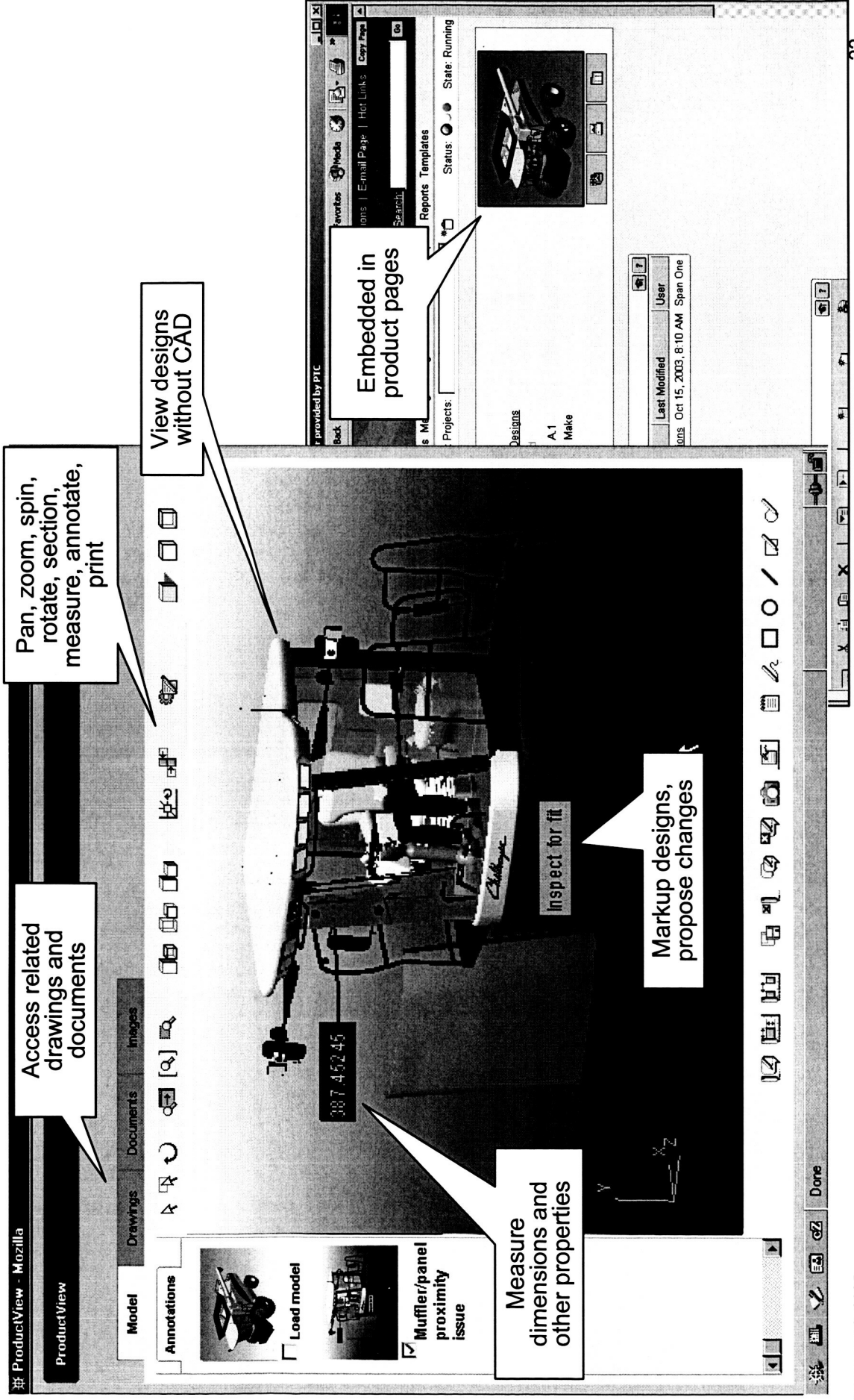


DDMS Lightweight Embedded Viewer



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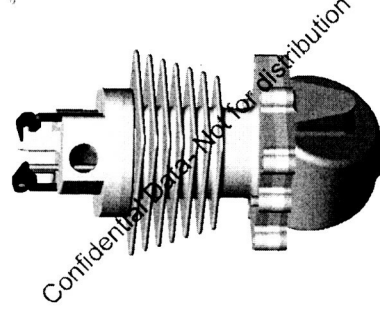
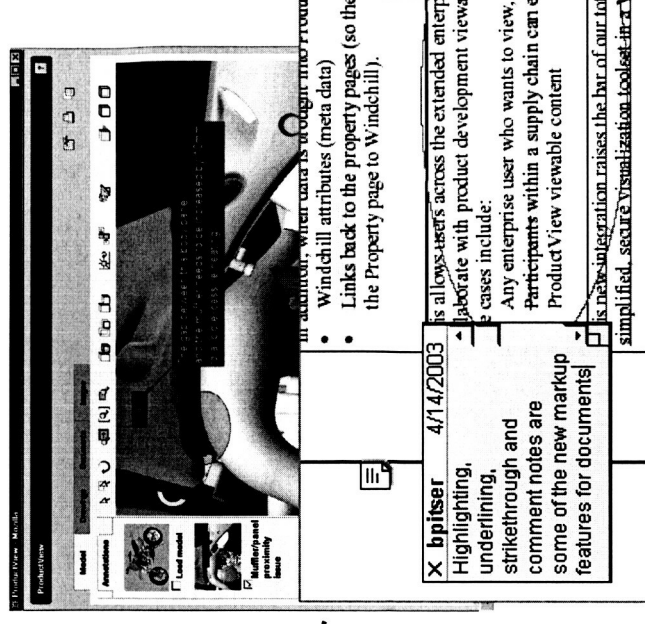


The screenshot displays the DDMS Lightweight Embedded Viewer interface within a Mozilla browser window. The interface includes a top navigation bar with tabs for ProductView, Drawings, Documents, and Images. A left sidebar contains a 'Model' section with 'Annotations' and 'Load model' options. The main viewing area shows a 3D model of a satellite with a callout '307.45245' pointing to a specific component. A toolbar on the right side of the model provides various manipulation tools. Several callout boxes highlight key features:

- Access related drawings and documents**: Points to the top navigation bar.
- Pan, zoom, spin, rotate, section, measure, annotate, print**: Points to the toolbar on the right.
- View designs without CAD**: Points to the 3D model.
- Measure dimensions and other properties**: Points to a callout box labeled '307.45245'.
- Markup designs, propose changes**: Points to a callout box labeled 'Inspect for fit'.
- Embedded in product pages**: Points to the browser window's address bar and status bar.

The browser window also shows a status bar at the bottom with 'provided by PIC', 'Back', 'Forward', 'Home', 'Email Page', 'Hot Links', 'Copy Page', 'Search', 'Reports', 'Templates', 'Status', and 'State: Running'.

- PDF Document Collaboration
 - Markup and viewing of non-CAD Adobe PDFs
 - Automatic creation of PDF files from Word and Excel as 'collaborative representations'
- Visualization Componentisation
 - 3D, 2D, ECAD, document, image viewers, PDF, for faster downloads
- Light client now supports markups (view, measure, markup)
- Embedded 3D thumbnails in product pages (spin, pan, zoom) (same size as 2D image size ~20-30KB)
- Enforce watermarking on content
- Support for Viewables in external file vaults



[Home](#)
[Product](#)
[Project](#)
[Change](#)
[Library](#)
[Organization](#)

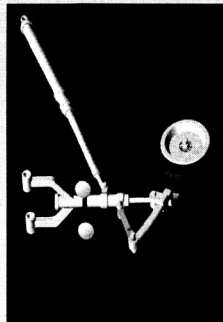
[Products List](#)
[Details](#)
[Folders](#)
[Product Structure](#)
[Team](#)
[Change](#)
[Monitor](#)
[Forum](#)
[Templates](#)
[Utili](#)

Crew Exploration Vehicle

 Recent Products:

this stupid little field is only 60 characters, the end is .

Crew Exploration Vehicle



Organization ID: Demo Organization

Responsible Product: Crew Exploration Vehicle

Number: CEV

Name: Crew Exploration Vehicle

Version: A.2

Type: Separable

Source: Make

Status: Checked in

Location: / Crew Exploration Vehicle

Product Structure —

Related Documents

Associated Changes

Used By

Replacements

Baselines

Effectivity

End Item Configurations

End Item Instances

Versions

Iteration History

Configuration: Latest 'Design' including work in progress

Relative

▼ Product Structure

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•Create and Edit Product Structure Effectively, Versions, and Views.

Imbedded Visualization

- Easier consumption of underlying information
 - locate items faster, confirm working on right items visually.
- Easy to provide feedback with available mark-up capabilities.
- Automated publishing and mark-up of PDF documents.
- CAD Tool not necessary

Capability to Manage, Navigate, and Visualize Product Structure

Current Situational Analysis



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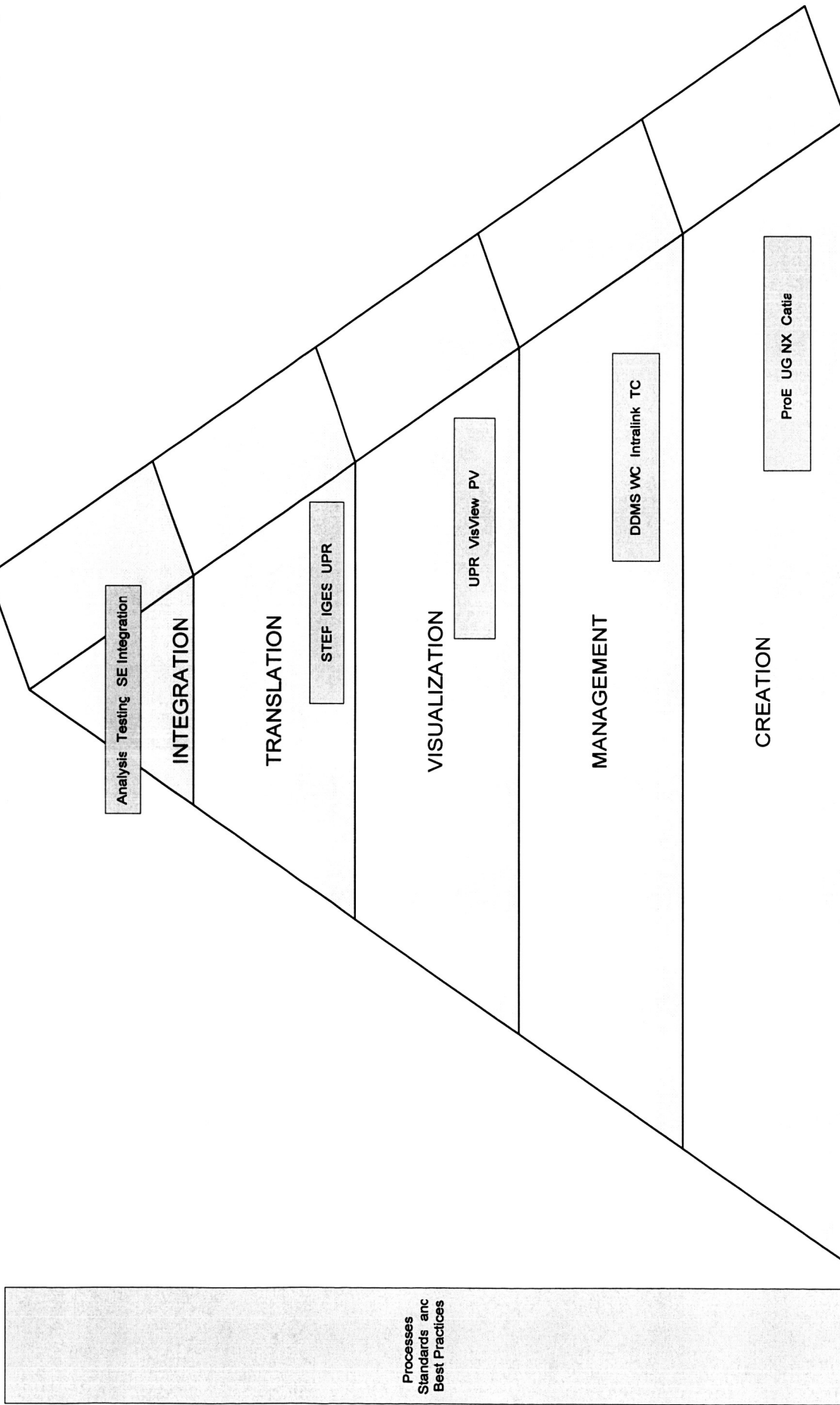
- There is presently a shift to paper from the modeled 3D electronic design to the 2D paper drawings being released. The design model presently still resides in the Teamcenter environment and the paper drawings along with the part information are being carried forward in the ICMS system. Parts lists are manually entered into ICMS and several manual approval workflows are initiated along with design checks to make sure the drawings are in sync and releasable.
- There are many manual downstream process steps that require model and paper drawing rework that could be improved with the implementation of an integrated engineering system. This would also help avoid the same part data being entered multiple times in multiple systems.
- There is limited configuration management capability of the design models currently being utilized.
- Models are re-drawn with different tools and systems by different groups.
- It is presently very difficult (if not impossible), requiring a lot of time and effort to integrate / re-integrate models to establish a full model definition of the product.
- There are no common Agency CAD tools or strategic direction defined.
- MSFC UG NX direction contrary to other NASA Centers based on MSFC business decision when evaluating Intergraph's CAD tool (acquired by UG) and PTC ProEngineer.
- There are Cultural Differences between Centers in their CAD approach and tools. The projects drive the toolsets and standards.
 - An example, LIDS project is mandating that MSFC engineers utilize their tools for the deliverables. The design process standards to do the work are MSFC specific. MSFC is in a inside contractor role.

IEC Multi-CAD Support



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Direct CAD Translation

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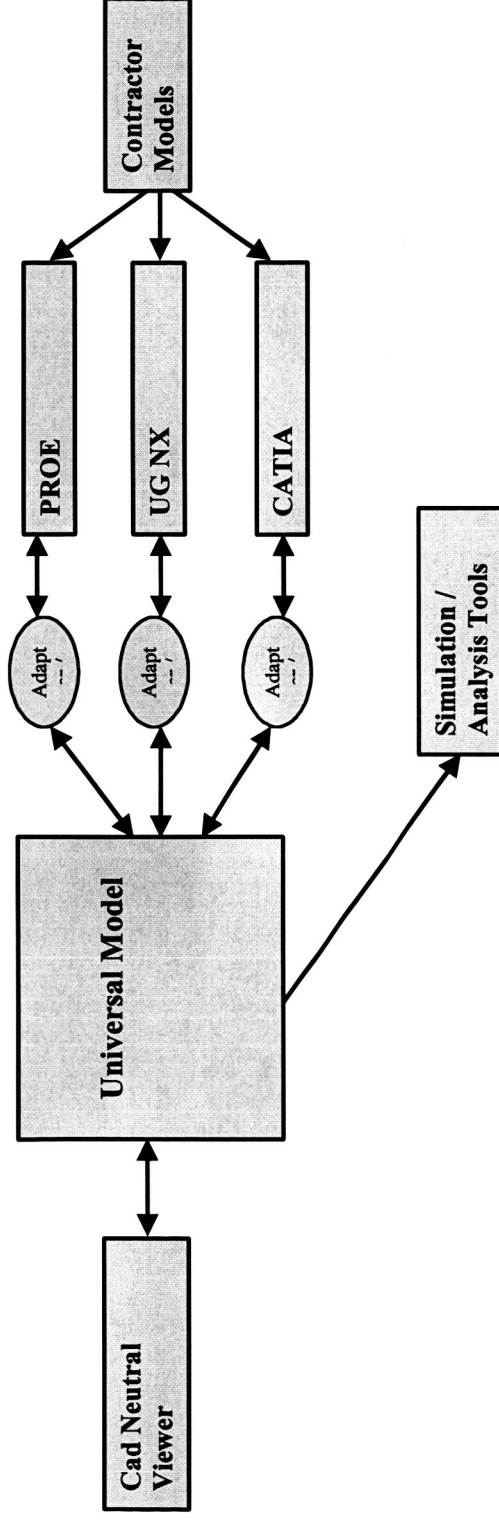
Popular methods of CAD data transfer.

- IGES Translator (Initial Graphic Exchange Specification)
- STEP Translator (Standard of Exchange of Product)
- Direct Feature Based CAD Translators
- Lightweight and Universal Models

Universal Model / Feature Based Translation

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Universal Model Approach

- Would allow for seamless Multi-CAD Integration
- Windchill could control models under CM

Workgroup Managers

- Workgroup Managers CAD to CAD Integration
- Would require purchase of all workgroup managers
- Workgroup Managers need further testing and reliability

Common themes throughout MSFC are the need for:

- (1) better contractor collaboration,
 - (2) the ability and tools to allow contractor delivery of native digital design data,
 - (3) the capability to better facilitate contractor insight/oversight functions within the projects.
- Contractors want to deliver model based deliverables.

CAD Data Utilization



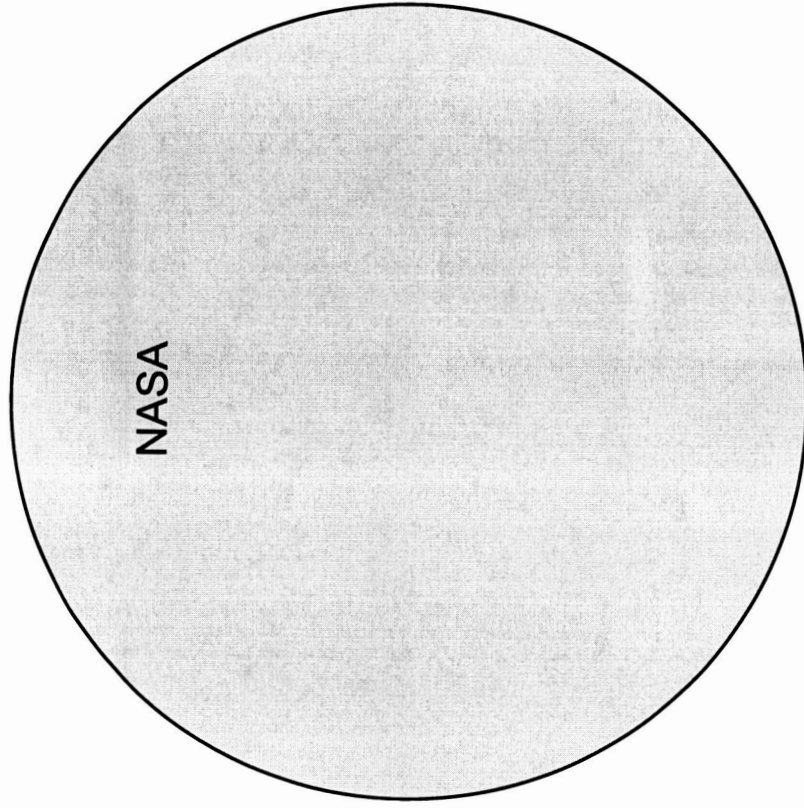
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Integrated Engineering Capability

- Mixed CAD Problem
 - 3D CAD plays a significant role
 - Organizations have standardized on different CAD tools
 - Sharing is a problem
 - There is no silver bullet

- Collaboration Density

Would standardizing on a CAD tool (format) provide significant advantages?



CAD Data Utilization

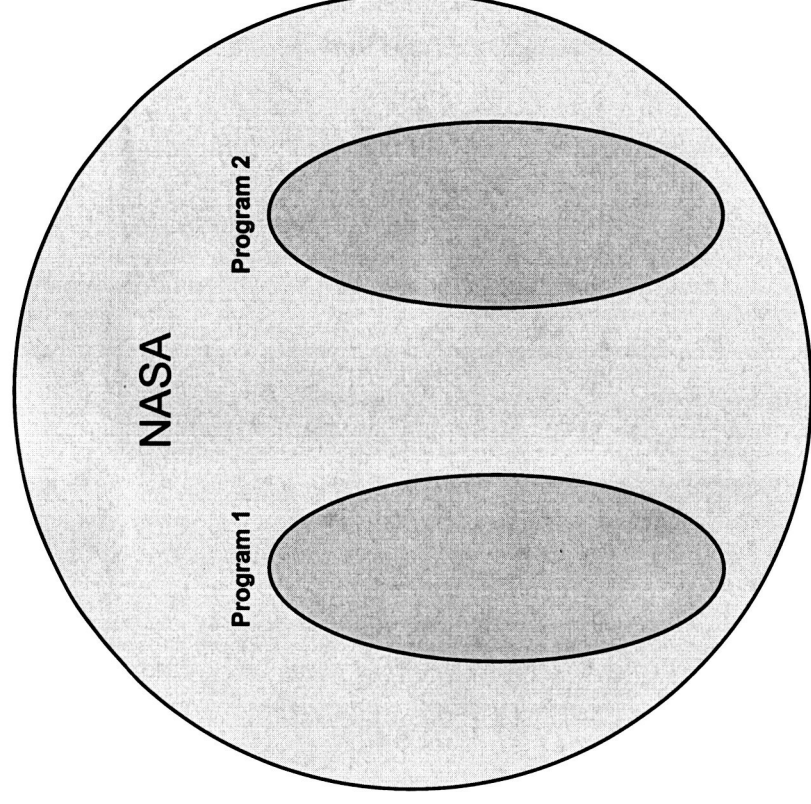


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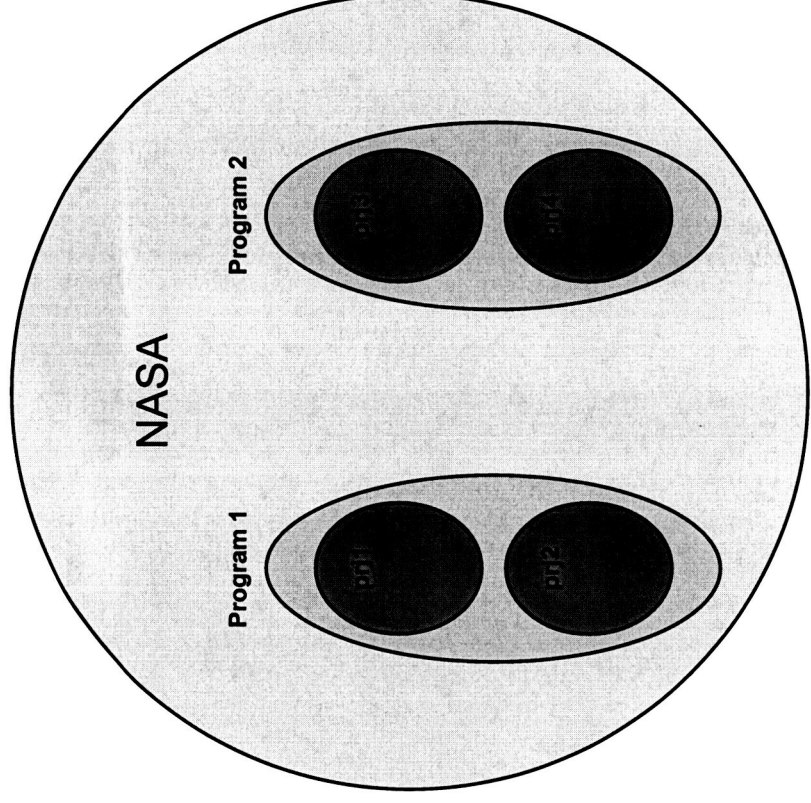
Integrated Engineering Capability

- Collaboration Density

Would standardizing on a CAD tool (format) provide significant advantages?

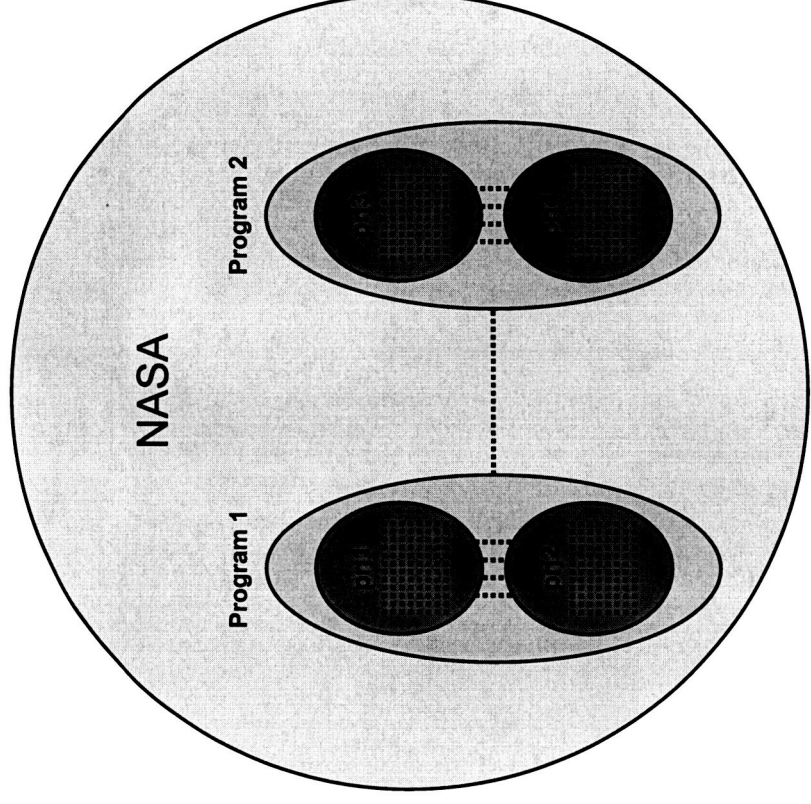


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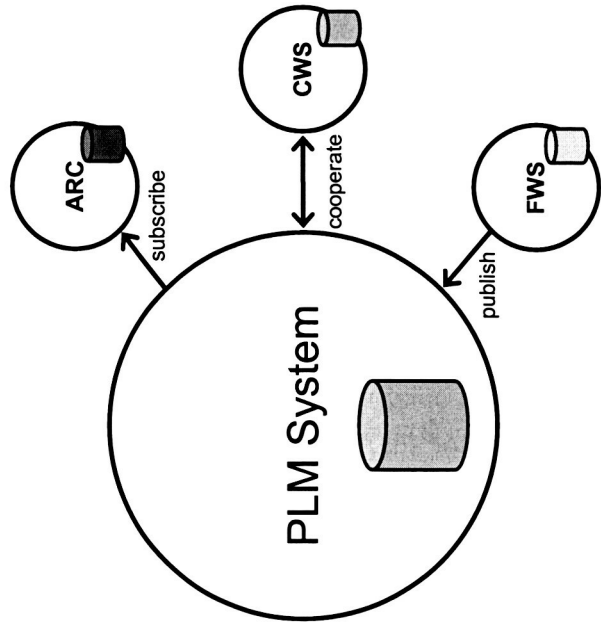


Focus efforts for the greatest benefit.

- Because organizations have standardized on different CAD tools, they have also standardized on different tools and methods for management.
- Differences
 - numbering schemes
 - revision sequences
 - approval methods
 - lifecycle states

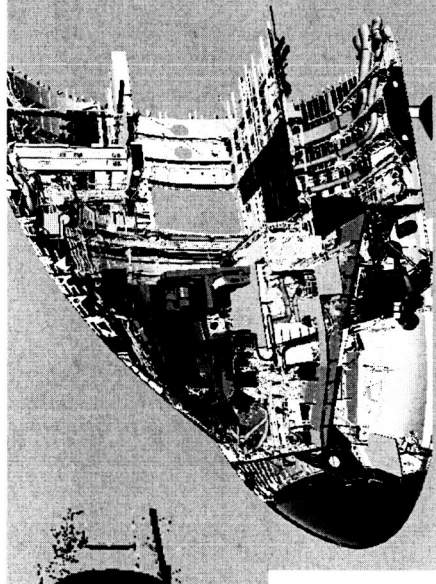
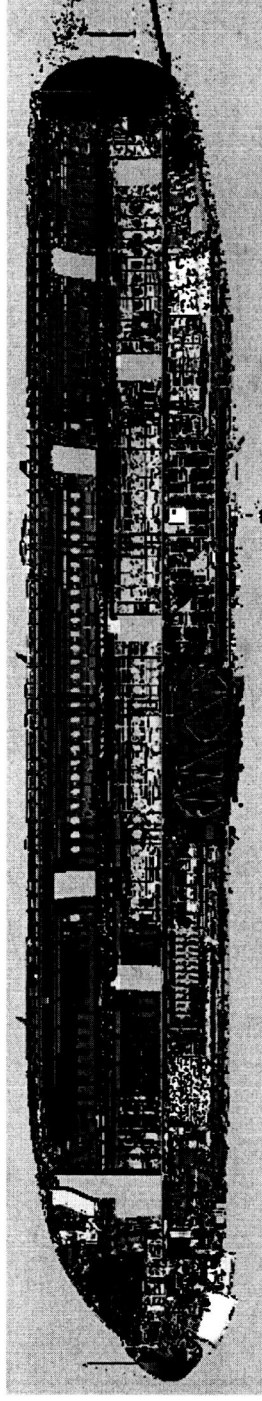
- PLM will be the central repository for CAD and Related Data

- So the design can be advanced.
- So there can be problem analysis.
- So there can be transfer of ownership.
- So it can be controlled (config managed).
- Because it will be easier to manage.
- So it can be used in collaboration.

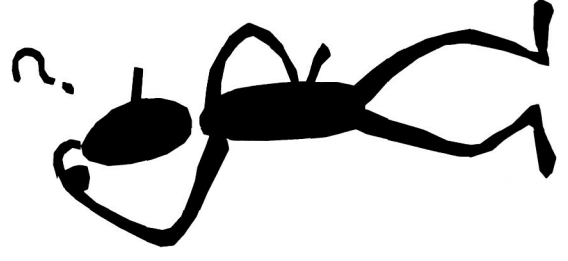


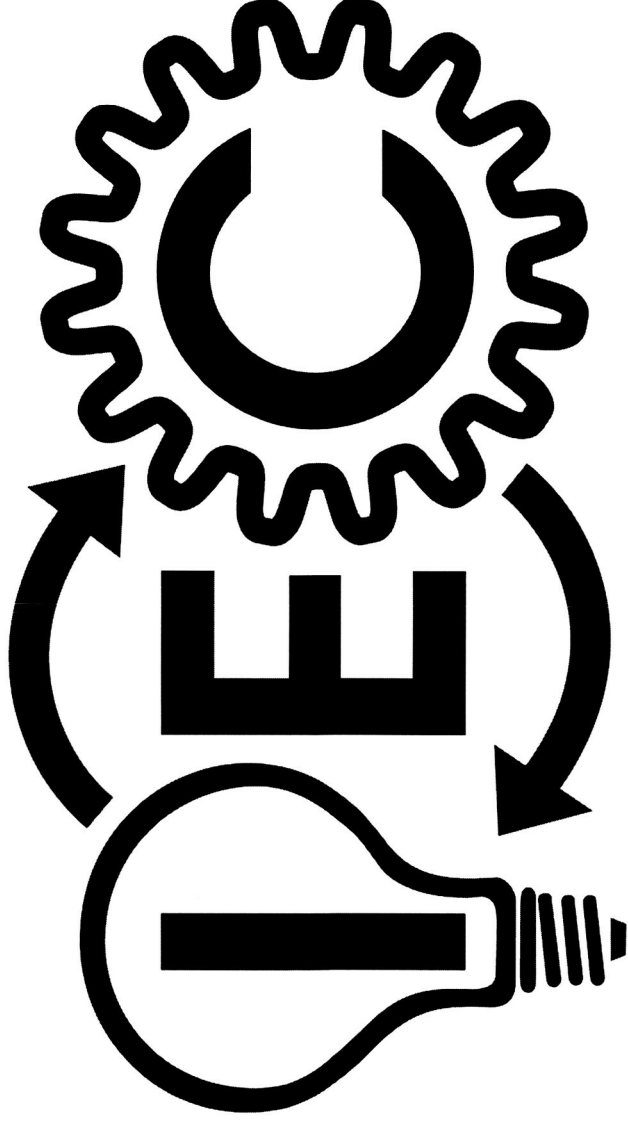
- CAD Visualization

Lightweight representations offer some relief from the mixed CAD problem



Questions





INTEGRATED ENGINEERING CAPABILITY